TOPIC: 193009
KNOWLEDGE: K1.01 [2.3/2.8]
QID: P2694

In a reactor operating at full power, the fuel assembly with the highest linear power density always has the...

A. greatest axial peaking factor.

B. greatest radial peaking factor.

C. smallest coolant flow rate.

D. smallest critical heat flux.

ANSWER: B.

TOPIC: 193009
KNOWLEDGE: K1.01 [2.3/2.8]
QID: P2794 (N/A)

A reactor is operating at 75% power at the middle of a fuel cycle with radial power distribution peaked in the center of the core. All control rods are fully withdrawn and in manual control.

Assuming all control rods remain fully withdrawn, except as noted, which one of the following will cause the maximum steady-state radial peaking (or hot channel) factor to decrease?

A. Turbine load/reactor power is reduced by 20%.

B. A control rod located at the edge of the core drops into the core.

C. Reactor coolant system boron concentration is reduced by 10 ppm.

D. The reactor is operated continuously at 75% power for three months.

ANSWER: D.

TOPIC: 193009
KNOWLEDGE: K1.02 [2.3/2.8]
QID: P1195

A reactor is operating at 80% power near the beginning of a fuel cycle. All control rods are fully withdrawn and in manual control. The moderator temperature coefficient is negative. Core axial power distribution is peaked below the core midplane.

Which one of the following will significantly decrease the core maximum axial peaking (or hot channel) factor? (Assume no subsequent operator action is taken and that main turbine load and core xenon distribution do not change unless stated.)

A. One bank of control rods is inserted 10%.

B. One control rod fully inserts into the core.

C. Turbine load/reactor power is reduced by 20%.

D. Reactor coolant system boron concentration is reduced by 50 ppm.

ANSWER: C.

TOPIC: 193009
KNOWLEDGE: K1.02 [2.3/2.8]
QID: P2894

A reactor is operating at steady-state 80% power at the beginning of a fuel cycle. All control rods are fully withdrawn and in manual control. The moderator temperature coefficient is negative.

Which one of the following will increase the maximum core axial peaking factor? (Assume <u>no</u> subsequent operator action is taken and that turbine load and core xenon distribution do <u>not</u> change unless stated.)

A. One bank of control rods is inserted 10%.

B. Power is maintained constant for one month.

C. Turbine load/reactor power is reduced by 20%.

D. Reactor coolant system boron concentration is increased by 50 ppm.

ANSWER: A.

TOPIC: 193009
KNOWLEDGE: K1.04 [2.3/2.7]
QID: P3295

A PWR core consists of 50,000 fuel rods; each fuel rod has an active length of 12 feet. The core is producing 1,800 MW of thermal energy. If the nuclear heat flux hot channel factor, $F_Q(z)$, (also called the total core peaking factor) is 2.0, what is the maximum local linear power density being produced in the core?

A. 4.5 kW/ft

B. 6.0 kW/ft

C. 9.0 kW/ft

D. 12.0 kW/ft

ANSWER: B.

TOPIC: 193009
KNOWLEDGE: K1.04 [2.3/2.7]
QID: P3794

A PWR core consists of 50,000 fuel rods; each fuel rod has an active length of 12 feet. The core is producing 1,800 MW of thermal energy. If the nuclear heat flux hot channel factor, $F_Q(z)$, (also called the total core peaking factor) is 1.5, what is the maximum local linear power density being produced in the core?

A. 4.5 kW/ft

B. 6.0 kW/ft

C. 9.0 kW/ft

D. 12.0 kW/ft

ANSWER: A.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P56

The basis for the maximum power density (kW/foot) power limit is to...

A. provide assurance of fuel integrity.

B. prevent xenon oscillations.

C. allow for fuel pellet manufacturing tolerances.

D. prevent nucleate boiling.

ANSWER: A.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P94

If a reactor is operated within core thermal limits, then...

A. plant thermal efficiency is optimized.

B. fuel cladding integrity is ensured.

C. pressurized thermal shock will be prevented.

D. reactor vessel thermal stresses will be minimized.

ANSWER: B.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P396 (B1793)

The 2200°F maximum peak fuel cladding temperature limit is imposed because...

A. 2200°F is approximately 500°F below the fuel cladding melting temperature.

B. the rate of the zircaloy-steam reaction increases significantly at temperatures above 2200°F.

C. any cladding temperature higher than 2200°F correlates to a fuel centerline temperature above the fuel melting point.

D. the thermal conductivity of zircaloy decreases rapidly at temperatures above 2200°F causing an unacceptably sharp rise in the fuel centerline temperature.

ANSWER: B.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P894

During normal operation, fuel clad integrity is ensured by...

A. the primary system relief valves.

B. core bypass flow restrictions.

C. the secondary system relief valves.

D. operating within core thermal limits.

ANSWER: D.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P994

Maximum fuel cladding integrity is attained by...

A. always operating below 110% of reactor coolant system design pressure.

B. actuation of the reactor protection system upon a reactor accident.

C. ensuring that actual heat flux is always less than critical heat flux.

D. ensuring operation above the critical heat flux during all operating conditions.

ANSWER: C.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P1194

Reactor core peaking (or hot channel) factors are used to establish a maximum reactor power level such that fuel pellet temperature is limited to prevent _________ and fuel clad temperature is limited to prevent ________ during most analyzed transients and abnormal conditions.

A. fuel pellet melting; fuel clad melting

B. excessive fuel pellet expansion; fuel clad melting

C. fuel pellet melting; excessive fuel clad oxidation

D. excessive fuel pellet expansion; excessive fuel clad oxidation

ANSWER: C.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P1295

Reactor thermal limits are established to...

A. ensure the integrity of the reactor fuel.

B. prevent exceeding reactor vessel mechanical limitations.

C. minimize the coolant temperature rise across the core.

D. establish control rod insertion limits.

ANSWER: A.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P1395 (B1893)

Thermal limits are established to protect the reactor core, and thereby protect the public during plant operations which include...

A. normal operations only.

B. normal and abnormal operations only.

C. normal, abnormal, and postulated accident operations only.

D. normal, abnormal, postulated and unpostulated accident operations.

ANSWER: C.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P2194 (B2194)

Which one of the following describes the basis for the 2200°F maximum fuel clad temperature limit?

A. The material strength of zircaloy decreases rapidly at temperatures above 2200°F.

B. At the normal operating pressure of the reactor vessel a clad temperature above 2200°F indicates that the critical heat flux has been exceeded.

C. The rate of the zircaloy-water reaction becomes significant at temperatures above 2200°F.

D. 2200°F is approximately 500°F below the fuel clad melting temperature.

ANSWER: C.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P2595

The linear power density thermal limit is designed to prevent melting of the _________ during normal reactor plant operation; the limit is dependent on the axial and radial peaking factors, of which, the _________ peaking factor is the most limiting.

A. fuel clad; axial

B. fuel clad; radial

C. fuel pellets; axial

D. fuel pellets; radial

ANSWER: D.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P2696 (B2693)

A reactor has experienced a loss of coolant accident. Inadequate core cooling has resulted in the following core temperatures one hour into the accident:

90% of the fuel clad has remained below 1800°F
10% of the fuel clad has exceeded 1800°F
5% of the fuel clad has exceeded 2000°F
0.5% of the fuel clad has reached 2200°F
0.0% of the fuel clad has exceeded 2200°F
Peak centerline fuel temperature is 4650°F

Which one of the following is an adverse consequence that will occur if the above fuel and clad temperature conditions remain constant for 24 additional hours followed by the injection of emergency cooling water directly to the top of the core?

A. Explosive hydrogen concentration inside the reactor vessel

B. Explosive hydrogen concentration inside the reactor containment building

C. Release of radioactive fission products due to melting of the fuel pellets and fuel clad

D. Release of radioactive fission products due to rupture of the fuel clad

ANSWER: D.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P2796 (N/A)

Given the following initial core parameters for a segment of a fuel rod:

Power density = 3 kW/ft
$T_{coolant}$ = 579°F
$T_{fuel\ centerline}$ = 2400°F

Reactor power is increased such that the following core parameters now exist for the same fuel rod segment:

Power density = 5 kW/ft
$T_{coolant}$ = 590°F
$T_{fuel\ centerline}$ = ?°F

Assuming no boiling occurs and coolant flow rate is unchanged, what will be the new stable $T_{fuel\ centerline}$?

A. 3035°F

B. 3614°F

C. 3625°F

D. 4590°F

ANSWER: C.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P2995 (B2292)

Which one of the following describes the basis for the 2,200°F maximum fuel clad temperature limit?

A. 2,200°F is approximately 500°F below the fuel clad melting temperature.

B. The rate of the zircaloy-steam reaction increases significantly above 2,200°F.

C. If fuel clad temperature reaches 2,200°F, the onset of transition boiling is imminent.

D. The differential expansion between the fuel pellets and the fuel clad becomes excessive above 2,200°F.

ANSWER: B.

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P383 (B394)

Refer to the drawing of a fuel rod and coolant flow channel at beginning of core life (see figure below).

Given the following initial core parameters:

Reactor power = 100%
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 3000°F

What would the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity were doubled? (Assume reactor power is constant.)

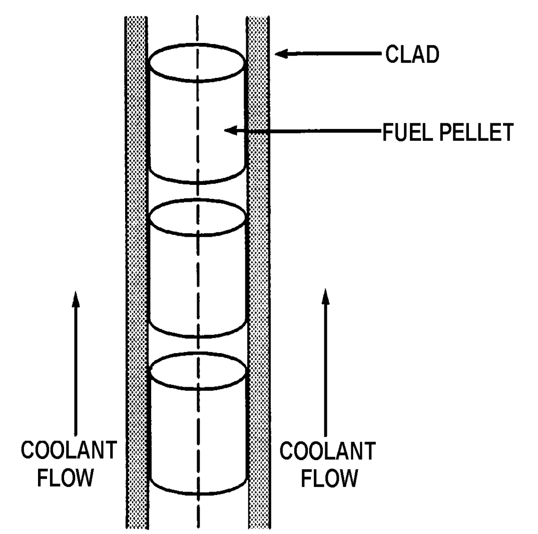
A. 2000°F

B. 1750°F

C. 1500°F

D. 1250°F

ANSWER: B.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P394 (B396)

The pellet-to-clad gap in fuel rod construction is designed to...

A. decrease fuel pellet slump.

B. reflect fission neutrons.

C. increase heat transfer rate.

D. reduce internal clad strain.

ANSWER: D.

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P495 (B495)

Refer to the drawing of a fuel rod and coolant flow channel (see figure below) at beginning of core life.

Given the following initial core parameters:

Reactor power = 100%
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 2500°F

What would the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity were doubled? (Assume reactor power is constant.)

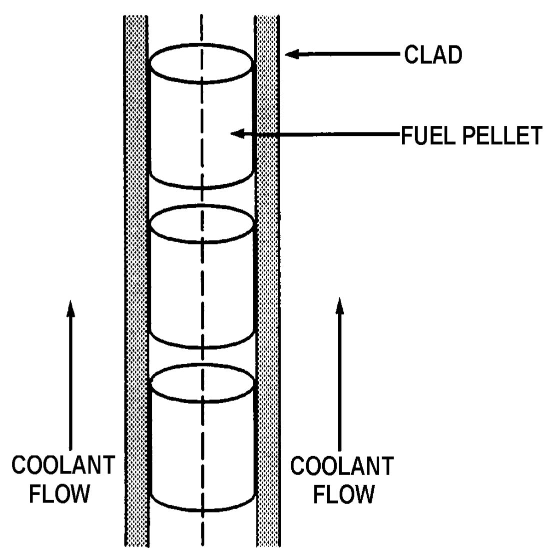
A. 1000°F

B. 1250°F

C. 1500°F

D. 1750°F

ANSWER: C.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P1095

A reactor is operating at 80% power with all control rods fully withdrawn. Compared to a 50% insertion of one control rod, 50% insertion of a group (or bank) of control rods will cause a ______________ increase in the axial peaking hot channel factor and a ______________ increase in the radial peaking hot channel factor. (Assume reactor power remains constant.)

A. larger; smaller

B. larger; larger

C. smaller; smaller

D. smaller; larger

ANSWER: A.

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P1594 (B1594)

Refer to the drawing of a fuel rod and coolant flow channel at the beginning of core life (see figure below).

Given the following initial core parameters:

Reactor power = 100%
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 2700°F

Which one of the following will be the fuel centerline temperature at the end of core life if the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power is constant.)

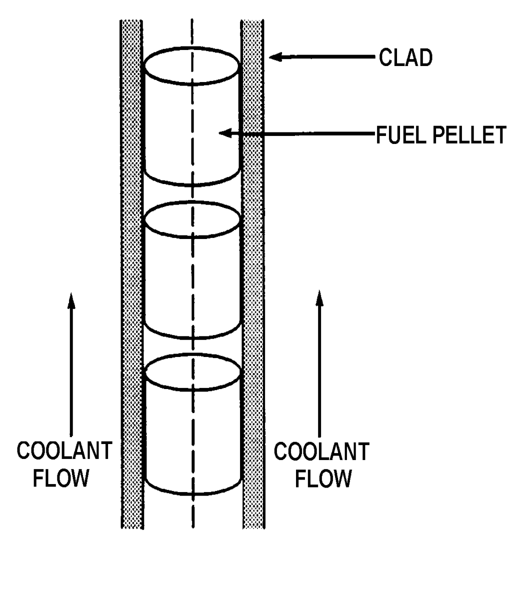
A. 1100°F

B. 1350°F

C 1600°F

D. 1850°F

ANSWER: C.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P1795

A reactor is operating at 80% power with all control rods fully withdrawn. Compared to a 50% insertion of a group (or bank) of control rods, 50% insertion of a single control rod will cause a ______________ increase in the axial peaking hot channel factor and a ______________ increase in the radial peaking hot channel factor. (Assume reactor power remains constant.)

A. larger; smaller

B. larger; larger

C. smaller; smaller

D. smaller; larger

ANSWER: D.

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P1894 (B1395)

Which one of the following describes the fuel-to-coolant thermal conductivity at the end of core life (EOL) as compared to the beginning of core life (BOL)?

A. Smaller at EOL due to fuel pellet densification

B. Smaller at EOL due to contamination of fill gas with fission product gases

C. Larger at EOL due to greater temperature difference between fuel pellets and coolant

D. Larger at EOL due to reduction in gap between fuel pellets and clad

ANSWER: D.

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P1994 (B1995)

Refer to the drawing of a fuel rod and coolant flow channel at the beginning of core life (see figure below).

Given the following initial core parameters:

Reactor power = 60%
$T_{coolant}$ = 540°F
$T_{fuel\ centerline}$ = 2540°F

Which one of the following will be the fuel centerline temperature at the end of core life if the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power is constant.)

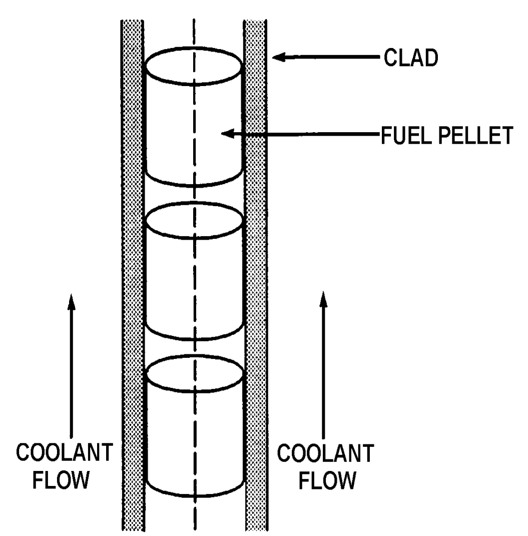
A. 1270°F

B. 1370°F

C. 1440°F

D. 1540°F

ANSWER: D.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P2195 (B2192)

Which one of the following describes the fuel-to-coolant thermal conductivity for a fuel assembly at the beginning of core life (BOL) as compared to the end of core life (EOL)?

A. Larger at BOL due to a higher fuel pellet density

B. Larger at BOL due to lower contamination of fuel rod fill gas with fission product gases

C. Smaller at BOL due to a larger gap between the fuel pellets and clad

D. Smaller at BOL due to a smaller corrosion film on the surface of the fuel rods

ANSWER: C.

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P2296 (B2696)

Refer to the drawing of a fuel rod and coolant flow channel at the beginning of core life (see figure below).

Given the following initial core parameters:

Reactor power = 60%
$T_{coolant}$ = 560°F
$T_{fuel\ centerline}$ = 2500°F

Which one of the following will be the fuel centerline temperature at the end of core life if the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power is constant.)

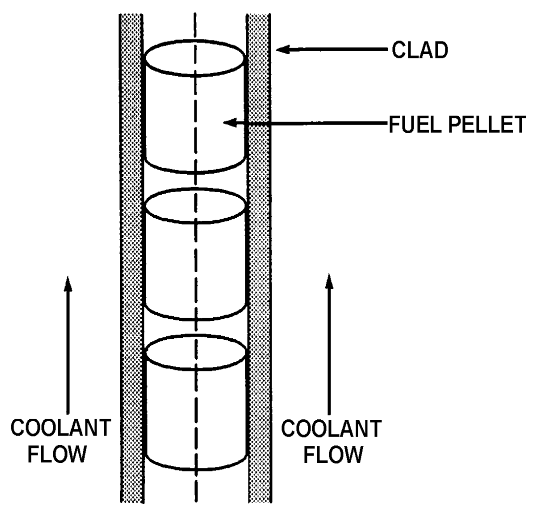
A. 1080°F

B. 1250°F

C. 1530°F

D. 1810°F

ANSWER: C.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P2395 (B2394)

Refer to the drawing of a fuel rod and coolant flow channel at beginning of core life (see figure below).

The reactor is shut down with the following parameter values:

$T_{coolant}$ = 320°F
$T_{fuel\ centerline}$ = 780°F

What would the fuel centerline temperature be under these same conditions at the end of core life if the total fuel-to-coolant thermal conductivity were doubled?

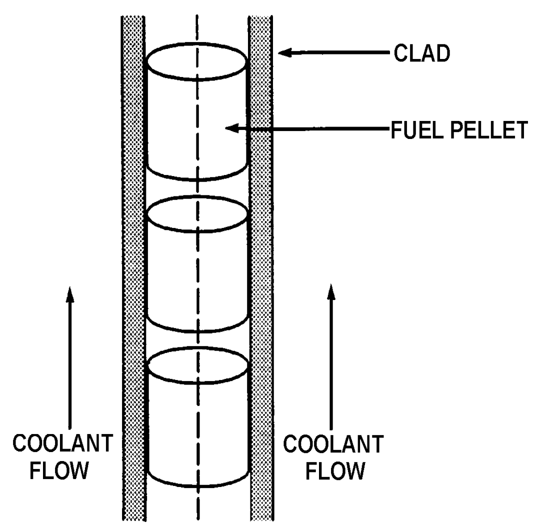
A. 550°F

B. 500°F

C. 450°F

D. 400°F

ANSWER: A.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P2594

A reactor is operating at steady state 80% reactor power with core power distribution peaked both radially and axially in the center of the core. Reactor coolant boron concentration changes are used to maintain a constant T_{ave} and control rod position does not change.

Neglecting any change in reactor poisons, during the next three months the maximum radial peaking factor will __________ and the maximum axial peaking factor will ___________.

A. increase; decrease

B. increase; increase

C. decrease; decrease

D. decrease; increase

ANSWER: C.

TOPIC: 193009
KNOWLEDGE: K1.07 [2.9/3.3]
QID: P3195 (B3193)

Refer to the drawing of a fuel rod and coolant flow channel (see figure below).

The reactor is shut down at the beginning of a fuel cycle with the following average parameter values:

$T_{coolant}$ = 440°F
$T_{fuel\ centerline}$ = 780°F

If the total fuel-to-coolant thermal conductivity doubles over core life, what will the fuel centerline temperature be with the same coolant temperature and reactor decay heat conditions at the end of the fuel cycle?

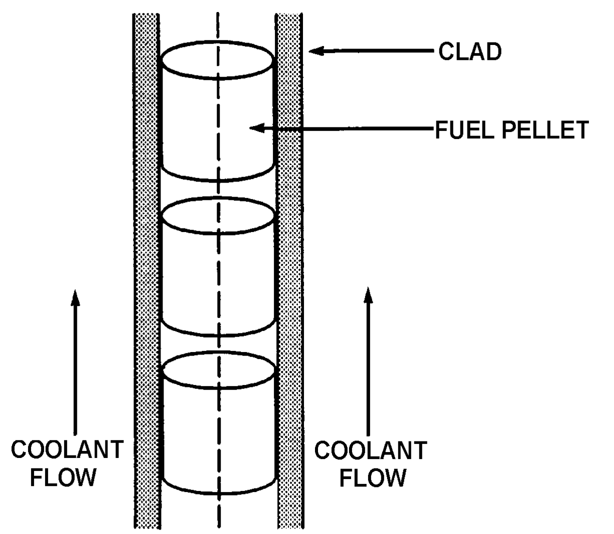
A. 610°F

B. 580°F

C. 550°F

D. 520°F

ANSWER: A.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 193009
KNOWLEDGE: K1.07 [2.9/3.3]
QID: P3395 (B1697)

Refer to the drawing of a fuel rod and coolant flow channel at the beginning of core life (see figure below).

Given the following initial core parameters:

Reactor power = 50%
$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 2750°F

What will the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power and $T_{coolant}$ are constant.)

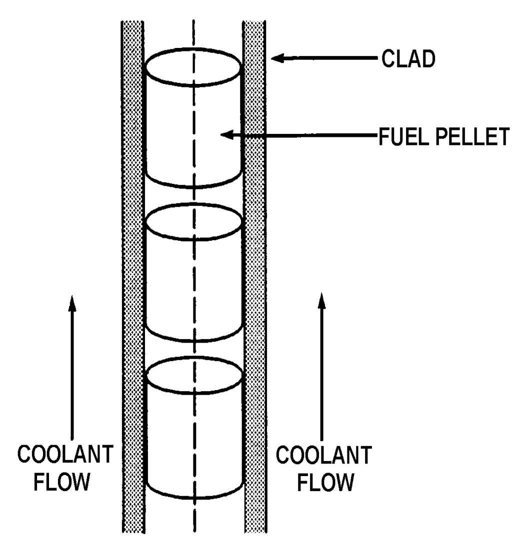
A. 1100°F

B. 1375°F

C. 1525°F

D. 1650°F

ANSWER: D.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 193009
KNOWLEDGE: K1.07 [2.9/3.3]
QID: P3895

Refer to the drawing of a fuel rod and coolant flow channel (see figure below).

Given the following initial stable core parameters:

Reactor power = 50%
$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 2,250°F

Assume that the total heat transfer coefficient and the reactor coolant temperature do <u>not</u> change. What will the approximate stable fuel centerline temperature be if reactor power is increased to 75%?

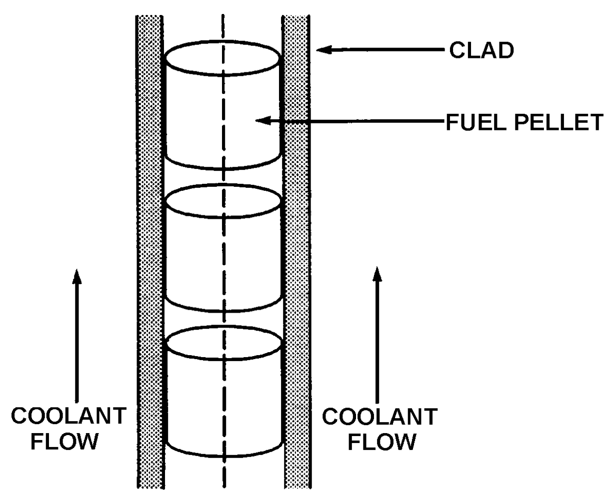
A. 2,550°F

B. 2,800°F

C. 2,950°F

D. 3,100°F

ANSWER: D.



FUEL ROD AND COOLANT FLOW CHANNEL